

Patent Application of

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for

TITLE: ON-DEMAND EJECTION FOR INJECTION MOLDS

CROSS-REFERENCE TO RELATED APPLICATIONS: Not Applicable

FEDERALLY SPONSORED RESEARCH: Not Applicable

SEQUENCE LISTING OR PROGRAM: Not Applicable

BACKGROUND OF THE INVENTION

1. Field of invention:

This invention relates to a system and method for increasing production efficiency and protecting injection molds.

2. Prior art:

Articles molded in an injection mold may not eject from the mold's first ejection sequence. The inherent characteristics of the material being molded, the geometry of the article, or molding imperfections, such as flash, often cause an unsuccessful first ejection sequence. Portions of molded articles may remain in the mold after the first ejection sequence due to a failure in the ejection system, breakage of the molded article, or insufficient material being supplied to the mold cavity. If the molded articles, or portions thereof, are not properly ejected from the mold prior to the mold closing, mold damage can occur or subsequent molded articles may be

defective. If multiple ejection sequences are performed to ensure that articles, or portions thereof, have ejected prior to mold closing, production efficiency is compromised.

Article-sensing vision systems and radiation emitting and receiving article sensors are currently utilized to protect injection molds, but these devices simply prevent the mold from initiating its next cycle and typically require operator intervention to correct the problem. If the time for the operator to react to the identified problem is significant, the material in the machine's barrel can degrade, requiring additional time and expense for the material to be purged. Molding machines are often equipped with a low-pressure mold protection feature, closing the mold at a lower pressure in an attempt to detect any resistance at mold closing due to an unwanted article in the mold. Low-pressure mold protection does not protect the mold when the low pressure is enough to damage the mold, or when improper ejection occurs often. To help reduce the potential for mold damage and reduce operator intervention, it is common to increase the amount of ejection sequences during the molding cycle, decreasing production efficiency. Increasing production efficiency, protecting the mold, increasing part quality, and reducing operator requirements are important since these directly relate to the cost of the molded articles and the competitiveness of the molder.

### 3. Objects and Advantages:

Accordingly, several objects and advantages of my invention are:

- (a) an increase in production efficiency by adding ejection sequences on demand
- (b) protection of the mold from closing on molded articles, or portions thereof
- (c) better quality by ensuring molded articles, or portions thereof, are properly ejected, not compromising the integrity of subsequent molded articles
- (d) a reduction in operator intervention

Further objects and advantages of my invention will become apparent from a consideration of the drawings and ensuing description.

### SUMMARY

This invention provides a method of performing ejection sequences in an injection mold on demand, increasing production efficiency and protecting the mold.

## DRAWINGS

Figure 1 is a perspective view of a mold equipped with article-detection devices

Figure 2 is a section view of the mold illustrating an improperly ejected article

Figure 3 is a section view of a through-beam radiation emitting and receiving article sensor

Figure 4 is a section view of a reflective radiation emitting and receiving article sensor

## DRAWING REFERENCE NUMERALS

- 10 Ejector-half of injection mold
- 12 Hot-half of injection mold
- 14 Article-sensing vision system
- 16 Through-beam radiation receiving sensor
- 18 Through-beam radiation emitting sensor
- 20 Reflective radiation emitting and receiving sensor
- 22 Mold ejector system
- 24 Article-detection controller
- 26 Molding machine controller
- 28 Connecting device
- 30 Molded article, or portion of an article
- 32 Radiation beam

## DETAILED DESCRIPTION

Figures 1 and 2 depict systems for detecting the presence of an article, or portion of an article 30, in the mold after the ejection sequence of the injection molding cycle has occurred.

Figure 1 illustrates an article-sensing vision system 14 mounted to the hot-half of the mold 12 and a through-beam radiation receiving sensor 16, a through-beam radiation emitting sensor 18, and a reflective radiation emitting and receiving sensor 20 attached to the ejector-half of the mold 10. Article-detection devices are not limited to article-sensing vision systems 14, and radiation emitting and receiving sensors 16,18,20. The simultaneous use of multiple article-sensing systems such as an article-sensing vision system 14 and radiation emitting and receiving article sensors 16,18,20 as depicted in Figure 1 is not required. The article-sensing vision system

**14** and radiation emitting and receiving article sensors **16,18,20** are electrically connected to the article-detection controller **24**. The article-detection controller **24** is connected to the molding machine controller **26**. The connecting device **28** between the article-sensing devices **14,16,18,20**, the article-detection controller **24**, and the molding machine controller **26** could be any connecting device known to the ordinarily skilled artisan such as, and not limited to, electrical cords, wiring, cables, or fiber optic cables.

Figure 2 illustrates an article, or a portion thereof **30**, in the mold after the ejection sequence of the injection-molding cycle has occurred. Figure 3 illustrates how an article, or portion thereof **30**, not properly ejected from the mold would be detected by through-beam radiation receiving and emitting sensors **16,18**. The improperly ejected article, or portion thereof **30**, interferes with the radiation beam **32** emitted from the through-beam radiation emitting sensor **18**, preventing the through-beam radiation receiving sensor **16** from detecting the radiation beam **32**. Figure 4 illustrates how an article, or portion thereof **30**, not properly ejected from the mold would be detected by a reflective radiation emitting and receiving sensor **20**. The radiation emitters and receivers **16,18,20** could be any device known to the ordinarily skilled artisan and could be, and not limited to, infrared light sources, white light sources, light emitting diodes, photoresistors, photodiodes, phototransistors, or photovoltaic cells. These devices also include appropriate lenses to increase detecting distances and modify the detection area.

#### OPERATION – Figure 1 and Figure 2

When the article-detection devices, such as the article-sensing vision system **14** or radiation emitting and receiving article sensors **16,18,20**, detect a molded article, or portion of an article **30**, the article-detection controller **24** is alerted of the condition. The article-detection controller **24** enables the molding machine controller **26** to perform an additional ejection sequence on the mold ejector system **22**. The mold ejector system **22** can encompass all methods of ejection known to the ordinarily skilled artisan such as, and not limited to, mechanical ejection and pneumatic ejection. If the molded article, or portion thereof **30**, is not detected by the article-detection devices after the second ejection, the mold is allowed to close and start its next cycle. If the molded article, or portion thereof **30**, is detected by the article-detection devices after the second ejection, subsequent ejection sequences and inspections are performed to self-correct the

problem. After exhausting the predetermined number of ejection sequences, the molding machine controller **26** will signal for alternative intervention.

From the description above, a number of advantages of the system become evident:

- a) An increase in production efficiency will be realized since only the required amount of ejection sequences will be utilized in any molding cycle, eliminating the need to have a conservative amount of ejection sequences on every cycle
- b) The mold has increased protection from damage caused by closing on an improperly ejected article, or portion of an article, that remains in the mold
- c) Better quality by ensuring molded articles, or portions thereof, are properly ejected, not compromising the integrity of subsequent molded articles
- d) A reduction in operator intervention will be realized since the system will attempt to self-correct improperly ejected articles, or portions thereof, before signaling for alternative intervention

These advantages enable a higher production efficiency, lower labor cost, and better preservation of the mold than with existing methods.

Although the description above contains many specifics, these should not be construed as limiting the scope of the invention, but as merely providing illustrations of some of the presently preferred embodiments of this invention. For example, the article-detection controller and molding machine controller can be one and the same, wireless communications can be utilized to communicate between the devices, etc. The scope of the invention should be determined by the appended claims and their legal equivalents, rather than by the examples given.